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### Testo India Pvt Ltd

#### Head Office:

Plot No. 23, Sind Society, Baner Road, Aundh, Pune - 411007, Maharashtra, India  
Tel: +91 20 2592 0000 | Fax: +91 20 2585 0080 | Email: info@testo.in

#### Regional Offices / Representatives:

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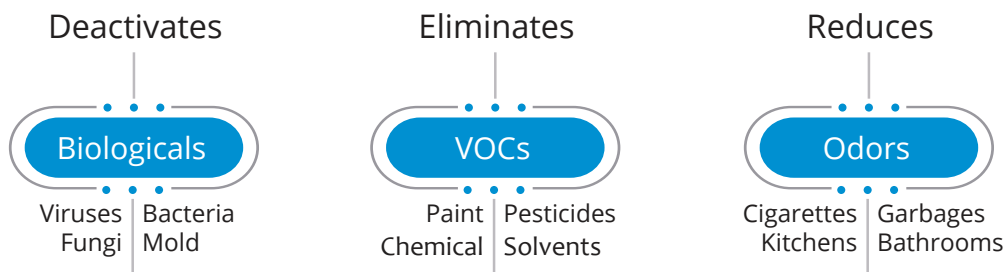
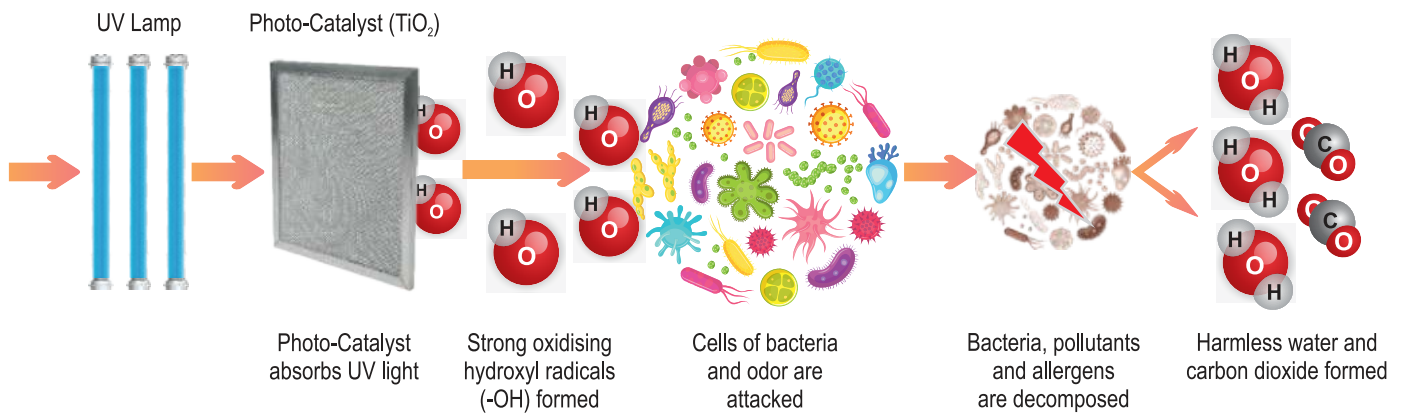
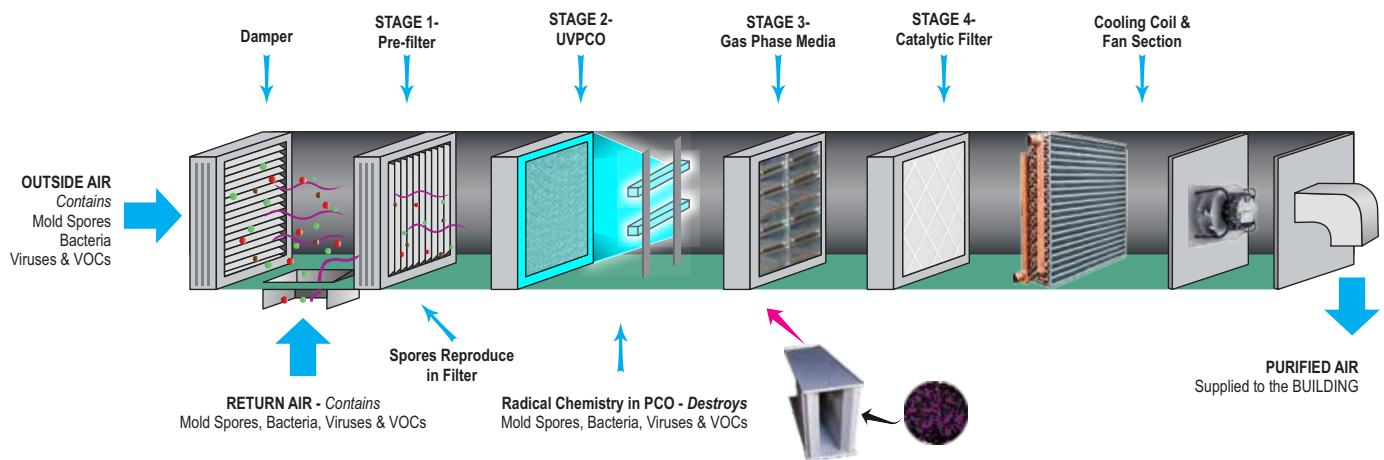
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# Publisher's Letter

## Let-Up To Feel New Normal

**W**e are living in a whole new world learning latest prevalent terminology such as pandemic, virtual, safety, masking, new normal, online shopping etc. They all are transitioning our perception and impacting behavioural shifts in looking at things. The global pandemic sets a new standard for the direction of change, disinfection and HVAC technologies, all aim at seeking to improve our future.

Further, HVACR sector has been punched at various levels of degree by the pandemic. Hotels, hospitality, entertainment and sports venues are struggling due to concerns over contracting the virus, even after they could reopen. In all likelihood, end-users are thinking about safety, sustainability and necessity in their spending behaviour with undefined alternatives, in the new normal times.

I go over to say again: my focus on the health and safety concerns of employees will continue to be a priority in our publication house. The global crisis triggered by COVID-19 pandemic has dented the supply chain and inventories. As business activities closed to operate; staff went remote and mostly online. This all is causing logistical challenges, disrupting relevant activities.

Yes, we are thankful to the authors for contributing articles to their own publication bringing latest knowledge and research about refrigeration and HVAC industry for our readers. And we, at Chary Publications continue attending webinars, networking sessions, to enable us provide readers with latest content. This October issue presents the coverage on refrigeration, packaging trends in food industry, impact on environment, cold supply chain and energy efficiency.

When it comes to environmental impact, food loss and waste generate eight percent of global greenhouse gas emissions. In terms of GHG emissions, the food lost is associated with around 1.5 gigatonnes of CO<sub>2</sub> equivalent every year, according to sources. Simply put, reducing food waste means more food for all, less GHG emissions, less pressure on environment, and positive growth. Reducing food loss early in the supply chain will open way for greater food security; therefore if we perform better it is conducive for overall growth.

Please do write to me with your inputs to serve you in the best possible ways at [pravita@charypublications.in](mailto:pravita@charypublications.in)

**Pravita Iyer**  
Publisher & Director



**Directors**  
Mahadevan Iyer  
Pravita Iyer

**Publisher**  
Pravita Iyer  
[pravita@charypublications.in](mailto:pravita@charypublications.in)

**Editor-in-Chief**  
Mahadevan Iyer  
[miyer@charypublications.in](mailto:miyer@charypublications.in)

**Commercial Director, Digital & Print**  
Pravita Iyer  
[pravita@charypublications.in](mailto:pravita@charypublications.in)

**Editorial Department**  
Gopal Krishna Anand  
[gopal@charypublications.in](mailto:gopal@charypublications.in)

**Editorial Assistant**  
Abegail D'mello  
[abegail@charypublications.in](mailto:abegail@charypublications.in)

**Design**  
Sachin Parabkar  
Jebas Thangadurai

**Design Concept**  
Abegail D'mello

**Accounts**  
Dattakumar Barge  
[accounts@charypublications.in](mailto:accounts@charypublications.in)

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**Chary Publications Pvt. Ltd.**  
906, The Corporate Park, Plot 14 & 15,  
Sector - 18, Vashi, Navi Mumbai - 400 703.  
**Phone: 022 27777170 / 71**

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**Editor: Mahadevan Iyer**

# START YOUR JOURNEY

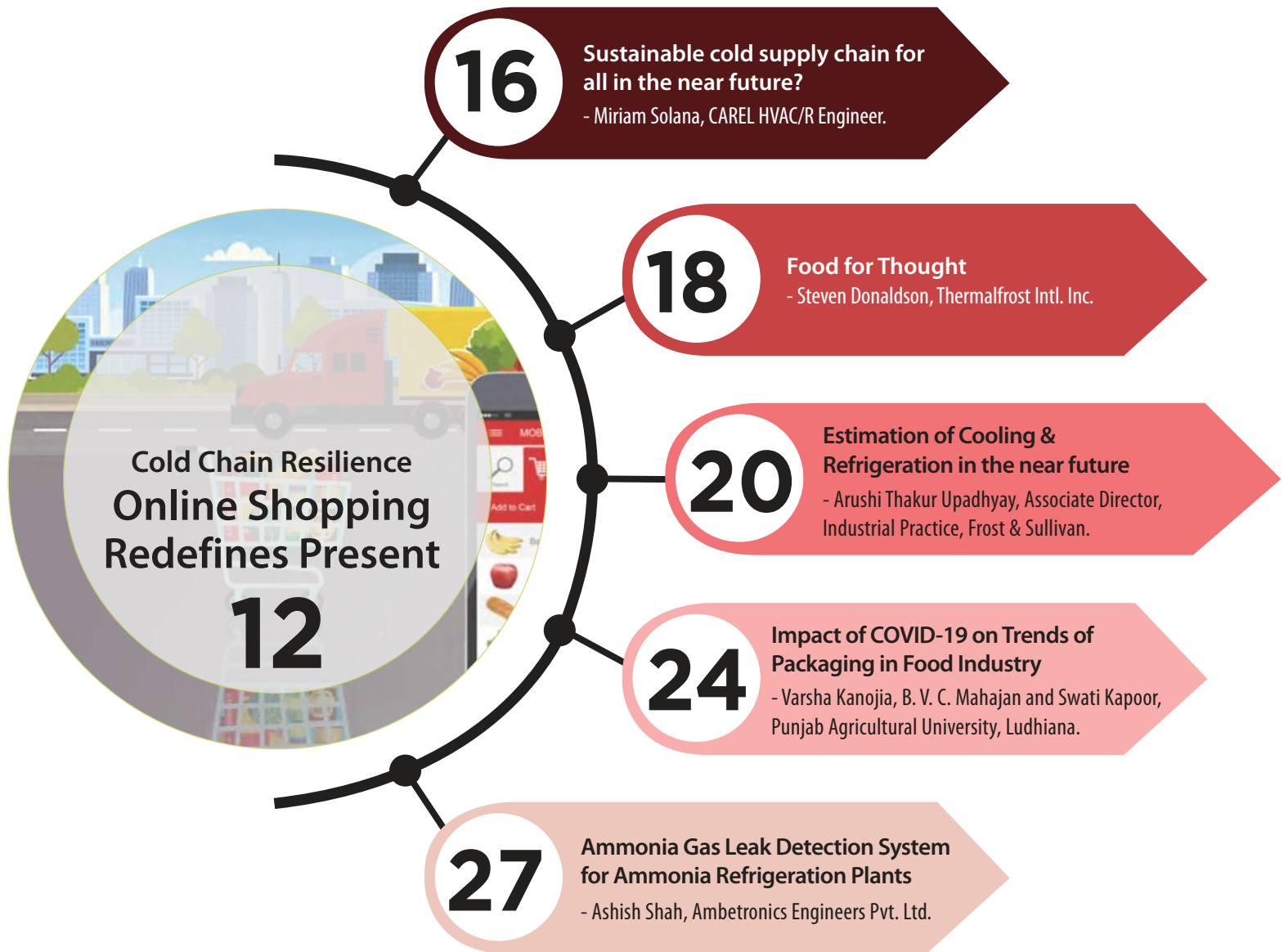
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## Airific Systems introduces UVHeal SafeAir to combat Airborne diseases



As the world is going through the worst ever public health crisis, multiple challenges are arising with infections taking place from viruses. Many of these viral infections are proven to be airborne. Experts, scientists and ASHRAE claim that viruses like COVID-19 can spread through indoor air circulation systems, which means that a single infected person can trigger the infection to countless others. To overcome this challenge of the pandemic, Airific Systems Pvt. Ltd., has introduced 'UVHeal SafeAir' – an ultra-modern 'UV-Based HVAC Air Disinfectant' for central air conditioning systems to break the spread of airborne diseases.

UVHeal SafeAir uses the proven UVGI (ultraviolet germicidal irradiation) technology to disinfect the circulated air by destroying the DNA or RNA of the dangerous viruses & bacteria present. The International Ultraviolet Association (IUA) & ASHRAE has also suggested that UVC disinfection technology can efficiently combat the viruses responsible for causing epidemics like COVID-19, SARS COV-1, SARS COV-2, MERS-COV, etc.

Ankit Sharma, Director, Airific Systems Pvt. Ltd. said, "At Airific Systems, we aim to work on a consumer-centric approach where we bring future-driven technology that makes the lives of our customers joyful. The ongoing COVID-19 pandemic has adversely affected individuals as well as organizations. Now is the time when we adapt ourselves to the scenario. So, when it comes to the health, comfort, and well-being of the community, UVHeal SafeAir will turn out to be the most effective solution." ■

## Carrier launches Healthy, Safe, Sustainable Cold Chain Program



Image by Alexas\_Fotos from Pixabay

Carrier launched the Healthy, Safe, Sustainable Cold Chain Program – designed to help customers meet, rapidly evolving supply chain demands and make their cold chain activities more effective.

David Appel, President, Refrigeration, Carrier said, "The times we live in have increased the importance of cold chain

resiliency and accelerated the need for more connected solutions from origination to delivery. Carrier is leading the way in research and technologies that will help our customers supply the food, medicine and vaccines that can improve the health and well-being of the global population. We are uniquely positioned to support customers through our global installed base, broad service capabilities and decades of experience across the cold chain." This new program focuses on a health-first cold chain in four areas: viz., Food & Medicine Security, Safe Vaccine Distribution, Connected Cold Chain, Sustainable Cold Chain.

Carrier offers a leading portfolio of refrigeration and cargo monitoring solutions to support supply chain resiliency and product safety. It is in a position to address current and emerging cold chain challenges with an installed base of 1.2 million transport refrigeration units, more than 50,000 commercial refrigeration installations and comprehensive cargo monitoring capabilities including real-time solutions, theft prevention, thermal mapping solutions and logistics optimization.

Carrier continues to advance its digital capabilities, telematics and remote-monitoring offerings that deliver insights and connectivity across the cold chain. ■

## Lennox International introduces 'Building Better Air Initiative'

Lennox International (LII) launches the Building Better Air initiative to improve the indoor air quality of commercial spaces. This initiative combines the company's innovative product line and industry-leading building services to provide comprehensive IAQ solutions for various commercial applications.

Elliot Zimmer, President and Chief Operating Officer, Lennox Commercial, said, "Over the past six months, we have all experienced change in the way we work, shop, and socialize. The COVID-19 pandemic has highlighted the key role that HVAC plays in healthy building environments and Lennox is making sure that our customers have access to the right products and services to get back to business safely."

Lennox International offers a variety of industry-leading Commercial HVAC products, when paired with a comprehensive maintenance plan, enable businesses to improve indoor air quality. Air purification, ventilation, and humidity control technology can be applied to HVAC systems to improve the safety of building environments for employees and customers.

Bobby DiFulgentiz, Vice President, Product Management and Marketing, Lennox Commercial, said, "The Building Better Air initiative is structured to help business and building owners evaluate the current state of their HVAC systems, recommend a comprehensive indoor air quality solution tailored to the building and identify a maintenance plan to ensure ongoing effectiveness." ■

## NewCold 'On Course' with new cold storage facility in UK



NewCold, regarded as a leader in developing and operating highly automated cold stores and energy efficient handling systems. The preparations for its second UK deep freeze storage facility are fully on course, and following the build commencement, the operation is expected to go live just one

year later. Based in Corby, the facility sits on a 23-acre plot which, says **Country Director Jon Miles**, is a prime location in the logistics 'golden triangle', with proximity to frozen distribution centres of large retail and food service customers and perfectly located to help customers reduce food miles and cut costs.

He explains, "Everything is going as per plan for the new site and given the high demands being placed on our Wakefield facility, even with its colossal 4 million-pallet annual turnover, our target date for opening in the fourth quarter of 2021, hardly seems soon enough." Even though the Wakefield hub has a giant storage capacity of 143,000 pallets and is only just over 5 years old, NewCold were already making plans early in 2019 to establish an additional site further south in the UK.

Corby is ideally situated to support UK frozen food manufacturers and importers looking to enhance their supply chain value. In keeping with NewCold's focus on sustainability and as demonstrated at their uniquely designed Wakefield site, the new facility will use around 50% less energy than a conventional cold storage operation. Jon said, "This, coupled with our ability to reduce food miles by using high-volume trailers, will greatly reduce CO2 emissions and energy use." ■

## Focused action for mitigation of Air Pollution

Centre and state will work together to implement steps to combat air pollution, but more needs to be done. Environment, Forest and Climate Change Minister, Prakash Javadekar chaired a review meeting on the situation of air pollution which has been a recurrent environmental concern in winter season in Northern India especially in Delhi NCR region over last few years. Five states Delhi, Uttar Pradesh, Haryana, Rajasthan and Punjab participated in the meeting.

In an effort to combat air pollution caused due to stubble burning, the centre has allotted a fund of Rs. 1700 crore to the states for stubble management. Currently, 80% subsidy to cooperatives and 50% subsidy to individuals on machineries for stubble is being provided to curb pollution caused due to stubble burning.

He further added that the trial of Pusa Microbial Decomposer Capsule is underway in Delhi NCR and Uttar Pradesh will be using this technology over an area of 10,000 hectares this year and Delhi will be using the same for 800 hectares as informed by Environment Ministers of these states during the meeting. He also stated the importance of using Bio Decomposers, Bio CNG and Bio power to reduce air pollution and its negative impact.

There are several other factors that contribute to air pollution other than stubble burning which include constructions and demolition waste, poor waste management, unpaved roads and dust management, Bio mass burning, etc. He informed about several measures taken by the centre like BS VI norms have been introduced; power plants of Badarpur have Sonipat have been closed. Eastern and Western Peripheral Expressways have helped massively in reducing vehicular air pollution in Delhi and nearly 60,000 vehicles are diverted from Delhi which earlier used to go through Delhi. ■

## BSRIA 'Compressor Study' available from September 2020

BSRIA published the first of its series of regional reports on the Compressor market for Heating, Air Conditioning and Refrigeration. The report focuses on detailed product sales, with indications of production levels. The different compressor types covered in this study include rotary, scroll, reciprocating, screw and centrifugal with focus on HVAC applications with separate data on air conditioning, air to water or water to water heat pumps and refrigeration. Transport applications are excluded.

The first reports being published cover the Americas and China regions. They reveal contrasting pictures in terms of applications. In the Americas, refrigeration is the largest segment in the market, with high volumes of hermetic reciprocating compressors for residential applications. Air conditioning is the second largest application due to a vast residential and light commercial market. Rotary and especially scroll AC compressors are the most popular in this segment. The heat pump market is in a nascent state in Americas.

China has been a global production hub for compressors for some time now and this continues to be the case. Sales of compressors for air conditioning are the highest, followed by refrigeration units. Sales of compressors for heat pumps remain small in comparison. Despite their difference of magnitude, both markets are expected to experience similar hurdles and economic woes in 2020-2021. The ongoing coronavirus crisis will be impacting China in 2020, but the recovery towards pre-pandemic levels is expected relatively quickly. In the Americas, refrigeration will drive growth, despite a drop in air conditioning and heat pump markets, but the market is expected to take slightly longer to recover fully. Both regional reports are available from September for purchase. The India report will be published in mid-October, followed by the EMEA, Japan and South East Asia reports before the end of the year. ■



## Lineage Logistics named to Fortune's 2020 'Change the World' List

**L**ineage Logistics, LLC, the world's largest and most innovative temperature-controlled industrial REIT and logistics solutions provider, announced its inclusion as number 31 in Fortune's 2020 "Change the World" list.

Fortune recognized Lineage's social and environmental impact through two award-winning energy innovations – a redesigned and optimized blast freezing process and an energy efficiency and scheduling algorithm known as 'flywheeling'. Blast freezing is the process by which perishable food is rapidly cooled below 0°F to lock in nutrients and maintain its quality and longevity for storage and transport. Flywheeling reduces energy consumption and optimizes energy costs by analyzing historical usage and National Weather Service data to forecast weather and predict when peak demand for energy usage will occur to super-cool the warehouse in advance.

**Greg Lehmkuhl, President and CEO of Lineage**, "On an average, our facilities contain the freezing equivalent of approximately 150,000 home freezers – making electricity one of the largest opportunities to reduce waste across the network and putting us at the frontline of the energy conservation within the broader logistics industry." He remarks, this recognition is a testament to the creativity and dedication of the entire Lineage team, and we are honored to be recognized by Fortune as a company that is driving positive change at a time when it is needed most.

This announcement highlights the company's continued commitment to living its purpose of transforming the food supply chain to eliminate waste and help feed the world. It follows Lineage's recognition by the U.S. Department of Energy's Better Plants program over two consecutive years (2019 and 2020) for its proprietary 'flywheeling' machine-learning algorithm and process and novel blast freezer design. ■

## UN Summit on Biodiversity calls for Green Recovery from COVID-19



Image by Greg Montani from Pixabay

**R**ecognizing the continued deterioration and degradation of the world's natural ecosystems, world leaders called for increased resolve to protect biodiversity at the UN during October. A record number of countries - nearly 150 countries and 72 Heads of State and Government - addressed the first ever Summit held on biodiversity to build political momentum towards the post-2020 global biodiversity framework, to be adopted at COP15 in Kunming, China next year.

**President of the General Assembly Volkan Bozkir** said, "A green recovery, with an emphasis on protecting biodiversity, can address these concerns, mitigate risks, and build a more sustainable, resilient world. Doing so can help unlock an estimated US\$10 trillion in business opportunities, create 395 million jobs by 2030 and encourage a greener economy."

**UN Secretary-General António Guterres** said biodiversity and ecosystems are essential for human progress and prosperity. "By living in harmony with nature, we can avert the worst impacts of climate change and recharge biodiversity for the benefit of people and the planet." In addition to leaders, the Summit heard from **HRH Prince Charles**, who called for a new 'Marshall Plan' or a 'blue-green recovery' and indigenous leaders who, as defenders of biodiversity, spoke about the need to allow indigenous people to use their traditional knowledge to preserve, protect and manage nature.

**UNEP Executive Director Inger Andersen** remarked the Summit showed a greater willingness to act. "Today we have seen tremendous commitment to act, invest and drive action for a nature-positive world. ■

## International Day of Awareness of 'FLW' for food security and environmental sustainability

**F**ood continues to be lost and wasted. This year an increase in food loss and waste was witnessed as a result of movement and transport restrictions due to the pandemic. Marking the first International Day of Awareness of Food Loss and Waste (FLW), the UN Food and Agriculture Organization (FAO), the UN Environment Programme and their partners urged everyone to do more to reduce FLW or risk an even greater drop in food security and natural resources.

On top of this comes food waste, for which new estimates are coming out early 2021. Causes range from poor handling, inadequate transport or storage, lack of cold chain capacity, extreme weather conditions to cosmetic standards, and a lack of planning and cooking skills among consumers. "Food loss and waste is a big challenge of our time," said **FAO Director-General QU Dongyu**, "Innovative postharvest treatment, digital agriculture and food systems and re-modelling market channels offer huge potential to tackle the challenges of food loss and waste. We have just built a partnership with IBM, Microsoft and the Vatican to empower Artificial Intelligence in all these areas."

Calling food loss and waste "an ethical outrage" **António Guterres, United Nations Secretary-General**, in a message sent, urged everyone to play their part in tackling this issue – from countries setting a reduction target and measuring their food loss and waste and policy action in this area being included in climate plans under the Paris Agreement to businesses taking a similar approach and individuals shopping carefully, storing food correctly, and using leftovers. ■



Cold Chain Resilience

# ONLINE SHOPPING REDEFINES PRESENT

Globalism is ruling for corona virus which joins the list of viruses and bacteria that can be transmitted via food. And, preferably, online shopping for food remained legal throughout lockdown. In actuality, pandemic is enhancing the need for supply chain resiliency and creating opportunities for transport need from start-origin to end-delivery.

- Gopal Krishna Anand

**C**old Chain process requires temperature-controlled supply chain as transportation of food is always needed. Growth rate and trend of consumer delivery of chilled and frozen products, was rapidly expanding before start of the pandemic, but arrow-shoots now. The spread of the virus caused operational changes across the cold chain. Food quality and safety by preventing spoilage are major concerns to achieve. Hence, it has become all the more necessary for service providers to invest in





modern cold storage facilities, digitized vehicles, and system technologies. Now more than ever, the cold chain community feels to evaluate the lessons learned from the pandemic, and also the role that digitalization, automation and other innovations will play in the future.

A report, 'Preserving the Food Chain' outlines key protection and preservation technologies to help companies achieve significant reductions in both pre-consumer food loss and post-consumer food waste. **Lux Research Analyst and lead author of**

“ **UN to set a goal of reducing global 'Food Loss and Waste' by 50% till 2030** ”



**the report, Harini Venkataraman, Ph.D.,** noted, “Preservation and shelf life extension technologies are key across the agri-food and health ecosystems, something the pharmaceutical and pesticide industries have long understood. We are now seeing innovation and new solution development across the food supply chain, from pre-harvest preservation technologies to post-retail and in-home storage solutions.”

Further, a recently published survey conducted by Global Cold Chain Alliance (GCCA) finds that demand for data and predictive analytics is expected in the future. GCCA members store over 260 billion pounds of perishable foods each year, with an economic impact of \$6.1 billion annually.



**Jason Troendle, director of market intelligence and research at GCCA and author of the report '2020 COVID-19 Cold Chain Business Impact Survey Summary'** says, over 50% of respondents selected supply chain disruptions, keeping up with demand surge, slowdowns in food service,

production and manufacturing hurdles - as the biggest challenges in the cold chain.

On a positive note, market disruption provides cold chain shippers, an opportunity for a critical role in the food supply chain. The changes also provided an opportunity to try new processes that, if effective, may remain in place after the pandemic is over. Surprising findings in this research reveal that 55% indicated some revenue loss due to the pandemic. Optimism prevails about the future of industry, with 57% believing the pandemic will increase the expected growth rate of the cold chain. The top priority is workforce protection and access to personal protective equipment and cleaning supplies.

### Cold Chain challenge

The most obvious challenge that cold storage owners and third-party logistics providers (3PL) face are adequate temperature-efficient cold storage facilities and processes to ensure product quality and productivity. With the ongoing pandemic crisis, it's



good to learn new strides in supply chain management. **Kathy Fulton, executive director of American Logistics Aid Network (ALAN)** says, "Climate-controlled units and transportation services are always hugely valuable commodities, but especially at times like these when so many additional families need food."

## Market growth

Cold chain market is estimated to account for a value of \$203 billion in 2018 and is projected to grow at a CAGR of 7.6% from 2018, to reach a value of \$293 billion by 2023. The rise in consumer demand for perishable food items, growth of international trade due to trade liberalization, and expansion of the organized food retail industry are some of the factors driving the growth of the market. Government support for infrastructural development in several developing regions also fuels the growth of this industry.

Globalization has increased due to trade liberalization, advancements in transport infrastructure and communication technologies in the food retail sector. It has boosted international trade in perishable foods. Every region or country exports food and agricultural products that it produces and imports food products that it is deficient in. This has resulted in almost any fruit, vegetable, or processed food being available at local supermarkets all the year round. Several forces drive and enhance the trend of perishable commodities trade at the global level.



**Andre Patenaude, Director – Solutions Integration, Cold Chain, Emerson Commercial & Residential Solutions** remarked, even the most resilient food supply chains are being challenged in ways never imagined before the coronavirus pandemic. At the same time, consumers, retailers and regulators are demanding more visibility

and transparency into food's entire journey — from meat, dairy and produce plants all the way through to dinner tables. The food supply chain is one of the segments hardest hit by the pandemic. Consumers quickly switched their buying behaviors from brick-and-mortar stores to online groceries. Spikes in demand and disruptions throughout the food supply chain led to acute shortages of certain product categories.

## Energy costs concerns

High energy costs are a growing concern for cold chain providers. Energy costs are the highest in North America and Europe, followed by labor costs. Due to an increase in the number of refrigerated vehicles in North America and Europe, the main cause of concern for cold chain providers is the rising fuel costs and efficient management of fuel consumption, which depends on the type of product: frozen or chilled and the delivery route. Refrigerated

storage capacities are growing in Asia Pacific countries due to the need to reduce wastage of perishable foods.

## Robotics intervention

The new age equipment like wearable robotics can help protect workers. New grip technology allows robots to better grab products. Humans and robotics can work together for a more efficient warehouse. Armed with artificial intelligence, sensors and endless data, warehouses use cutting-edge robotics to close gaps in the supply chain as well as streamline operations and job functions. Robotics' intervention and usefulness in the cold chain warehouse cannot be denied, especially during the Coronavirus disease (COVID-19) outbreak.



**Kristi Martindale, chief customer officer and executive vice president, product strategy, Sarcos Robotics** says, "Before COVID-19, the cold chain market experienced consistent growth year-over-year. And the market value in 2017 as \$188.42 billion is estimated at \$269.61 billion by 2024. As a direct result of COVID-19, U.S. consumers

increasingly purchase their groceries online for either D2C delivery or BOPIS (buy online/pick up in-store). Because of this surge in grocery e-commerce, the cold storage market, along with the food industry at large, is facing significant disruption, growth opportunity and unique challenges. Robotics optimizes the hard-freeze process by improving speed, consistency and waste reduction, while automated storage and retrieval systems (AS/RS) enable higher storage density within cold storage warehouses to mitigate the surge in demand".

## Online grocery shopping

Refrigerated vans are always essential. Coronavirus has helped to push refrigerated vehicles to the forefront. As lockdown restrictions lessen, more and more people will naturally be returning to stores and carrying out their purchases in person again. The numbers of people are still remaining in isolation either by necessity or choice. Moving grocery shop online and having delivery drivers make rounds could actually mean that there are fewer cars on the road.

Here, coming across an example while exploring sites, following is worth sharing: "Imagine 10 families each getting in their cars and driving their 10 different routes to get to supermarket, and then loading up the cars and driving back again. Now imagine 1 delivery van making a loop around these 10 houses and returning to their point of origin. In this instance the same amount of food has been transported from store to home, but only 1 vehicle has made the journey, with the weight of only 1 or 2 people inside. There is a good chance that the overall journey was longer than any of the individual journeys, but it will undoubtedly be shorter than the 10 combined."

The online store would also reduce the amount of wasted energy that goes into lighting, heating, cooling and maintaining oversized stores.



## Trends in cold chain management

Cold chain supply sector is constantly evolving. The 2020 figure for buying groceries online is expected to show an uptick. With increased online demand, there is need for longer delivery routes and the need for mobile refrigeration. An online grocery store could also eliminate huge amounts of waste both in packaging, and in the amount of food destroyed, each and every day. Packaging needs to be more focused on efficiency than attraction. When people change their consumption patterns, suppliers of cold chain products have to adapt the changing needs, so must do the cold chain management operations as well. Some other ongoing trends are:

**Last mile delivery:** Freight companies are adapting to the need of getting consumer orders delivered at their doorstep by offering last mile delivery as an added service. In the context of supply chain management, the term “last mile” is used to refer to the final step of a product’s journey from the warehouse shelf to the consumer’s doorstep, eliminating the need for retail intermediaries.

### From farm to fork

- Cold Storage storing capacity 37-39 million tonnes in 2019
- Loss is highest for fruits and vegetables. at 5-16%
- 25% of the vaccines expire before reaching doctors and patients
- Indian wine industry annual turnover about USD 83 million.

Source: CBRE

**Less than truckload transportation:** With this solution, companies that sell food and pharma products, no longer have to pay for an entire trailer or full truck to deliver their shipment to the consumer market. All they need to do is to pay for the amount of space they use.

**GPS technology:** Businesses that deal in cold chain products want to know that everything is going on as planned and that the shipment will reach its destination on time. Even with refrigeration systems in place, temperature-sensitive products don’t last forever. Hence, delays in the delivery of certain food and pharmaceutical products can lead to huge losses.

**Essential medical supplies:** The cold chain shipment isn’t kept cold at every link of the chain, which is detrimental in the case of shipping vaccines, pharma products, and essential food items. Vaccines, when become defective and unsafe, need to be re-manufactured to protect the population. For cold chain logistics to be successful, qualified staff must be used at every step of the process, including storage, packaging, condition monitoring, and transport.

**Origin and handling of food:** The impacts of the pandemic increased the urgency - as the consumers want to know more about where their food comes from and how it’s been handled. According to Dan Crossley, executive director for Food Ethics Council, the question businesses should be asking is, “If our customers could

see everything about how our food is produced, distributed, stored and sold, would they still want my product?” One way to answer this question is by improving cold chain integrity.

**New normal: Verify food in-transit:** The supply chain begins at the point of harvest and continues through processing, cold storage and distribution — all before the food ever begins the last-mile delivery to a store, restaurant or consumer. The pandemic exposed areas of the global food supply chain that is susceptible to disruption by rapid changes in consumer behavior as well as food safety concerns. Food must be resupplied faster and kept fresh longer. Building these capabilities along with resiliency into the supply chain will require even more focus amid new normal. Those efforts will begin with the implementation of cold chain technologies that enable businesses to verify the condition of food at any and every step in its journey from producers to consumers.

## Online delivery specialism

Every temperature-sensitive product requires specialised handling to maintain its integrity along the cold chain. The control, connect and communicate is the answer to ensure efficient cold chain management. There are regulations and guidelines that industry regulators set for shipping companies to follow throughout the cold chain supply. With lockdown, importance of the online world has been thrown into the spotlight. Working from home becomes the new norm, and businesses like Amazon becoming ever more essential. As the online shopping has proven to be the more efficient way to sell goods to wider audiences, the supermarkets could move large portions of their trade online.

### Market Drivers

- Size of online F&G retail industry to quadruple by 2022 expected at USD billion 829
- Value of dairy industry in USD billion was 110 in 2017 and is expected at 259 in 2023
- Online Food Delivery (OFD) revenues in India to grow by more than 60% by 2023.

Source: CBRE

## Conclusion

Refrigerated technology is playing a huge role right now. The need for temporary cold storage—whether in refrigerated trailers, containers or available warehouse space has increased during the pandemic. There is need to move to more open and collaborative approach, since the cold chain involves maintaining a desired product within a specified low-temperature range from harvest/production to consumption. Even greater need is to go all-out for energy efficiency strategy, which may make fitting use of artificial intelligence’s latent potential in cold chain. The future demands using renewable energy and recycling waste energy into useful energy. Just to ponder- could the ‘New Normal Future’ will be the start of food shopping moving all online, while adapting to new ways of working into newer strategies. ■

## SUSTAINABLE COLD SUPPLY CHAIN FOR ALL IN THE NEAR FUTURE!



**W**as the second warmest year in the 140-year climate record, just behind 2016! What's more, the last five years have been the warmest in the period 1880-2019, confirming the increasing temperature trend of the planet.

The refrigeration and air conditioning industry plays an important role in both mitigating the effects of global warming and preventing it. On one hand, air conditioning of spaces and refrigeration of food are becoming more and more necessary as temperatures rise. On the other, greenhouse emissions that affect global warming can be significantly reduced by the use of low GWP refrigerants and more efficient cooling systems.

The objective is both ambitious and necessary: satisfying growing global cooling demand, without forgetting the most remote parts of the planet, while minimising direct and indirect greenhouse emissions.

In this scenario, this article aims to analyse the consequences of a lack of cooling and global warming, as well as the reasons why the cooling sector will grow in the future, highlighting the need to use efficient and smart technologies.

### Cooling for All

According to SEforALL, there are 1.05 billion people globally who

face risks related to a lack of access to cooling. The consequences are dire: limited access to nutritious food, essential health services and respite from rising temperatures.

As regards nutritious food, losses due to lack of refrigeration amount to 13% of food production. This means 475 million tonnes of wasted food, which could theoretically feed 950 million people a year! Considering that 821 million people were undernourished in 2018, an efficient cooling chain with the corresponding power supply could hypothetically have avoided undernourishment. Looking into the future, when world population is forecast to grow by 2 billion by 2050, the need for food will increase considerably and an efficient cold chain will become even more necessary.

The main role that cooling plays in the health services is refrigeration of vaccines. The World Health Organisation (WHO) estimates that more than half of freeze-dried vaccines, and 25% of liquid vaccines, are wasted every year due to intermittent power supplies and a lack of effective cooling. The concrete number of lives that could be saved by keeping that high number of vaccines correctly preserved is difficult to estimate, but it is easy to understand the size of the problem.

Moreover, rising global temperatures are causing increasingly frequent heatwaves, causing an estimated 12,000 deaths every

year. Owing to the effects of climate change, the WHO forecasts that these deaths will rise to 92,000 by 2030, and 255,000 by 2050. The spread of air conditioning systems to all sectors of society and the most underprivileged areas of the planet can help avoid many heat-related deaths.

The solution to these and other problems relating to the lack of cooling is one of the priorities of the United Nations (UN): some of the 2030 sustainable development goals such as “zero hunger”, “affordable and clean energy” and “good health and well-being” are directly correlated to improved access to cooling. Additionally, last November, 76 countries committed to supporting the development of a sustainable cold chain in the Rome declaration on the contribution of the Montreal Protocol, which stresses the importance of pursuing national action and international cooperation to promote cold chain development.

The objective of “Cooling for All” is ambitious, yet essential for the survival of many people living in the most underprivileged areas of the planet.

### Cooling for the Future

Demand for cooling will increase considerably over the next few years, according to experts. Specifically, it has been estimated that 4.8 billion new units of cooling equipment will be sold globally between 2019 and 2030, increasing annual sales to 460,000 units, up from 336,000 unit sales in 2018. In terms of energy consumption, this is forecast to almost double by 2050, to around 7,500 TWh annually, compared with 3,900 TWh in 2018.

Interestingly, the highest demand for cooling nowadays comes from domestic and mobile air conditioning: annual sales of household refrigeration, residential AC and mobile AC accounted for 92% of total annual cooling sales in 2018. These three sub-sectors will remain dominant in 2030. However, the fastest growth up to 2030 is expected for the industrial and transport refrigeration sectors.

Among the reasons why cooling demand will increase during the next years, climate change, urbanisation and income growth will surely play an important role.

Income growth is in part a by-product of economic development. As people reach a certain income threshold, they seek more conveniences such as air conditioning, especially in hot summer conditions.

Urbanisation also drives demand for cooling because cities tend to trap heat, increasing the probability of having air conditioning by 9 percent. More than half of the global population now lives in urban areas and this will rise to almost 70% by 2050, adding another 2.5 billion urban dwellers to the global total. Considering that the annual air temperature of a city with more than 1 million people can typically be between 1 and 3°C warmer than its surrounding areas, the need for cooling will surely increase as urban population grows.

Lastly, rising temperatures caused by climate change are also increasing demand. In the higher warming scenario – an increase of 2°C by around the year 2040 – the number of household air conditioners will increase by about 3% in Japan and up to 35% in France.



CAREL Heosone system



Hecu Gamma 2020

### Sustainable Cold Supply Chain

Cooling technologies are in turn, among the sectors that contribute to climate change - the cause of rising temperatures. Specifically, refrigeration and AC are estimated to account for around 7–10% of global CO<sub>2</sub> emissions, three times more than aviation and shipping combined! Ongoing measures aim to significantly reduce emissions and curb global warming. The substitution of fossil fuel based systems with heat pumps also helps to achieve this objective. Specifically, it has been estimated that the heat pump stock in 2018 saved 33.0 Mt of greenhouse gas emissions.

Technologies to help prevent that high consumption of cooling is being accompanied by an increase in CO<sub>2</sub> emissions need to be constantly improved. For this reason, CAREL is continuously developing and promoting natural, high efficiency and connected solutions for heating, ventilation, air conditioning and refrigeration equipment. Optimised and integrated components and systems are capable of bringing significant energy savings and consequently reducing the environmental impact of commercial, industrial and residential applications.

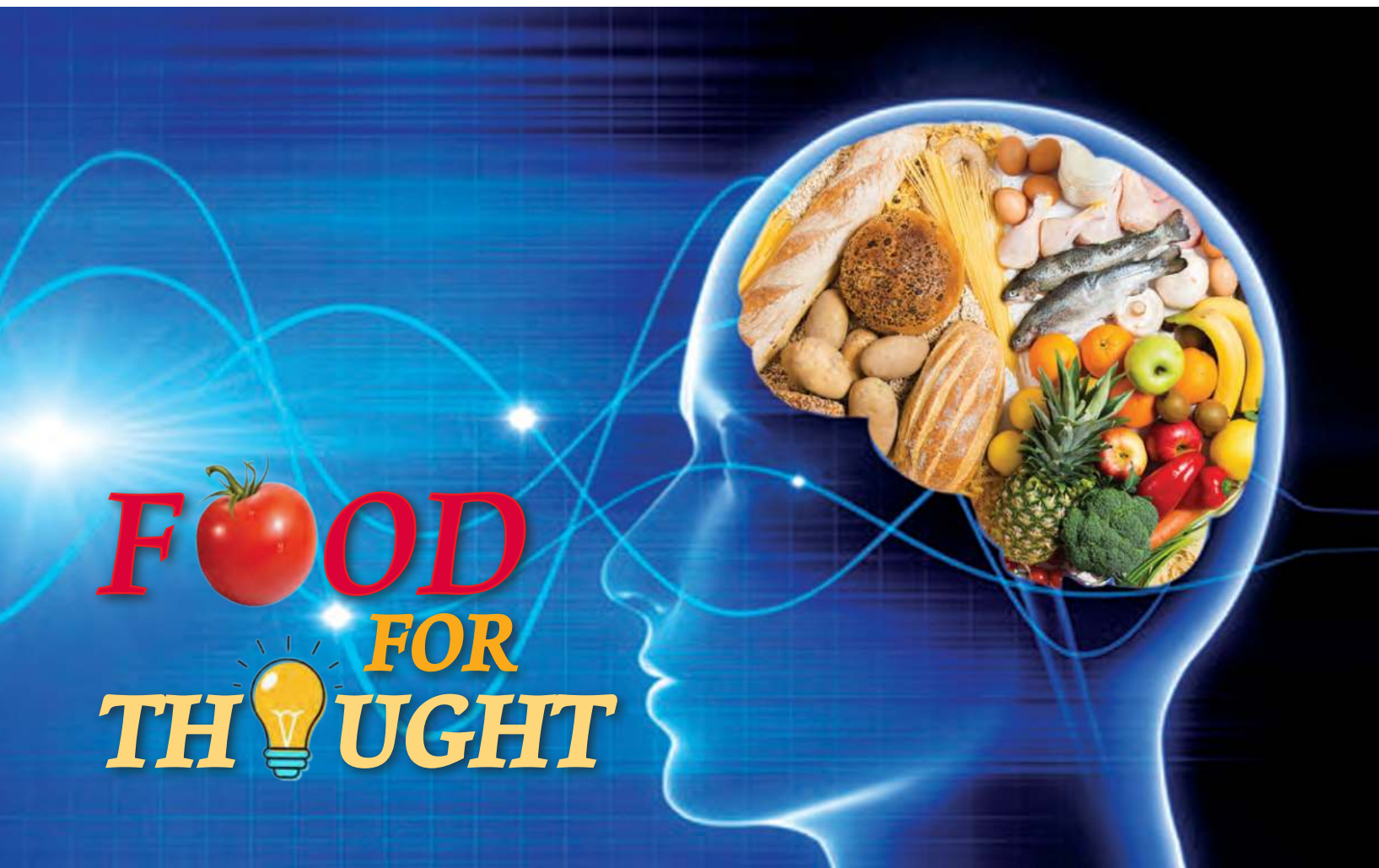
To sum up, stimulating wise technology selections, enhancing operations for minimising leakage of refrigerants and maximising energy efficiency are essential for sustainable cooling.

Hopefully, a ‘Sustainable Cold’ supply chain will provide a better life for ‘All in the near Future’.



**Miriam Solana,**  
CAREL HVAC/R Engineer.





As the biomass plants get more portable for distributed applications, like a mini biomass plant being developed by Sersa based Nano-Bio Graphite, the need for TES becomes even more important.

During my first travels to India some 30 years ago, if I were to capture my initial impressions in one word, it would be “diversity” – diversity in culture, diversity in food and diversity in geography. In recent years I have had the privilege to reacquaint myself with this wonderful country, augmenting my initial impressions with further diversity – diversity in innovative business.

Representing a Canadian company that manufactures vapour absorption chillers, my exposure to Indian business is linked to the cooling industry. I am greatly impressed by many innovators who are developing solutions to address one of India’s greatest needs – cooling. Today’s musings aren’t focusing on ThermalFrost’s core competency, but rather innovations I have been introduced to by Indian entrepreneurs, with an emphasis on Phase Change Materials (PCM) and their role in Thermal Energy Storage (TES).

In District Cooling plants, known benefit of TES is taking advantage of time-of-day electricity rates and the reduction of

capital expenditures on equipment like chillers. In the latter, TES can address peak cooling load allowing for chillers of lower cooling capacity to be installed. Moreover, chillers operate at highest efficiency when providing a level cooling load spread over time, as opposed to riding the roller coaster of peaks and valleys to meet typical cooling demand. In my observations, this feature of being able to spread the cooling load over time can have more application in India. For example, rather than dairy farms purchasing a large chiller to rapidly cool milk twice daily, why not install a small chiller operating at a constant level mode to charge TES? The TES can be discharged rapidly, cooling milk from 32°C to 4°C in less than 30 minutes.

Gurugram based PLUSS, a materials research company, is doing terrific work on advanced PCMs that can offer precise evaporation temperatures over a wide range of temperatures. Changing the physical state of materials (like liquid to solid) enables a lot more energy storage for a given volume. Water is an

excellent PCM, with an evaporation temperature of 1°C. However, for many cooling applications, a different temperature is ideal. PLUS can provide deep freezing PCMs suitable for many applications, including flash freezing of produce. At the other end of the temperature spectrum, sometimes higher temperatures are desired, like in the case of milk, or sometimes fruit at 12°C or 18°C. In addition to regulating temperatures at the desired level, TES in PCMs with higher phase change temperatures than water can raise the efficiency of chillers because instead of expending the energy to freeze water, they can change the physical state of a material ("freeze") at a higher, less demanding temperature.

I have had the privilege of visiting many farms across India and have been treated to organically grown vegetables immediately upon harvest – the freshness is palpable. I have learned the most important stage in the food cold chain is the immediate four hours upon harvest. For smaller farms, it is impractical and not economical to install a chiller on site, especially if electricity is unavailable or unreliable. Is this a potential application for TES? Companies like Pune based Absolute Cold and Global Cold Chain Solutions in Ahmedabad, make TES boxes of various sizes that can hold precise temperatures for long lengths of time. Commonly these boxes are used in the pharmaceutical industry to transport goods in a controlled environment. Might this be an economical solution for refrigerating produce immediately upon harvest? Farmers can store their harvest in these boxes, and when they take their produce to the local mandi might they fetch a better price? I see an opportunity for entrepreneurs who can supply farmers with these boxes and every time they return to the mandi with produce, removable PCM cartridges can be swapped with newly charged ones and the farmer can repeat the cycle. The business model can be flexible, and with increased quality in terms of the freshness of the produce, I see plenty of potential margins for mutually beneficial operations. Additionally, if a suitable buyer is unavailable, might the same entrepreneur be able to cold store the produce for sale on a future day? The same chillers used to charge the PCM cartridges, can be used to provide cold storage until a suitable buyer arrives, preserving the food cold chain. For refrigerated transport of the food from mandi cold storage to larger scale more centralized cold storage, PCM Trucks, like those used by Pune based Promethean can be used. These innovative trucks don't require a diesel consuming compressor on-board and can move the food long distances. There is no concern for chiller mechanical failure, not uncommon for journeys on long bumpy roads.

An important aspect behind these thoughts is the importance of TES for successful and efficient implementation of renewable energy. Pune based Ecozen have developed portable cold storage rooms driven by solar energy – charging in the daytime and able to keep produce fresh 24/7. Mysuru based Implantra as well as Physiz from Mumbai, are investigating different PCMs that can be used for similar cold storage and providing cooling for controlled environment agriculture. For solar thermal, or other heat sources, Physiz is implementing control systems to manage interoperability

between thermal chillers, TES, and various heat sources for diverse cooling applications. One such heat source is waste heat harnessed from the process of biomass power generation. In conjunction with Punjab Renewable Energy Services Private Ltd. ("PRESPL"), and Thermal Frost, Physiz is implementing a control system to manage the interoperability between PRESPL and Thermal Frost equipment with various cooling environments, including District Cooling and Cold Storage. By collecting crop stubble which in the past would have been burned in open fields polluting our air, PRESPL is turning this negative into a positive by controlling this burn to generate power. This "green" initiative will be enhanced by making more use of the generated heat to produce cooling. As these biomass plants get more portable for distributed applications, like a mini biomass plant being developed by Sersa based Nano-Bio Graphite, the need for TES becomes even more important.

To continue with the idea of PCM boxes in which farmers bring their produce to the mandi, I believe a real business and environmental argument can be made for new cold rooms, that also charge the PCMs to return to the farmer, to be operated with chillers driven by renewable energy. Whether it is at a mandi, or another community/co-op based location, imagine solar or crop stubble being used to generate electricity with the waste heat used to provide cooling, reducing food spoilage and improving its quality. Is there a better path to doubling farmer's income by 2022?

An underlying benefit to creating frameworks that take advantage of TES is the obvious impact on reductions in air pollution and GHG emissions, both directly and indirectly. Just the GHG emissions associated with replacing the global food supply lost to spoilage due to a lack of refrigeration exceeds the total emissions of the largest emitting countries in the world. Directly, facilitating the use of renewables reduces our dependence on fossil fuels and GHG emissions associated with our electricity grids. Perhaps most importantly, as an enabler for renewable energies, TES makes distributed energy more feasible. When we generate power, most of the consumed energy is lost in the form of waste heat. When power is generated centrally, finding a purpose for this waste heat is difficult. Distributing power generation to points in proximity to where it is being used (our communities, schools, hospitals, and industrial parks) facilitates combined heat and power, enabling us to make use of this waste heat, decreasing electrical consumption and raising efficiency.

As we all rethink what our new world will be like post-pandemic, the distributed models, like working from home or our energy solutions, make even more sense! With its richness in diversity, including innovative leading-edge businesses, I believe India is well positioned for this new world. ■



**Steven Donaldson**  
President, Thermal Frost Intl. Inc.  
Innovators in Thermal Cooling.





In an interview with Cooling India Arushi Thakur Upadhyay, Associate Director, Industrial Practice, Frost & Sullivan shares a detailed assessment of the Cooling and Refrigeration Sector in India.

## Estimation of Cooling & Refrigeration in the near future

**Could you provide a brief assessment of the Cooling sector in India? What is the market demand for various cooling solutions and what is the market growth trajectory for the cooling and HVAC&R sector?**

The overall cooling demand in India is currently estimated at 23,000 MT which is expected to grow at 2.8 times by 2028. Space Cooling will contribute the majority of the demand with a 68% share approximately, followed by refrigeration, transport, air conditioning, and cold chain. The overall HVAC (Heating, Ventilation, and Air Conditioning) market in India is approximately ₹ 28,000 Crore in FY20. The room air conditioner market contributes to 60% of the market share according to Frost &





Image by Erich Westendarp from Pixabay

Sullivan's analysis. Overall, room air conditioners expect to have positive growth due to climate change and an increase in adoption. The current penetration of room air conditioners in India is low at around 6%, while the global average is 55%. Commercial ACs may see a sluggish growth due to slow-down in new establishments as well as reduction of footfall in commercial space. Currently, COVID-19 has impacted the market to a great extent creating uncertainty. Most corporate offices are considering 'work from home' as the 'new normal'. In FY18 space cooling, energy consumption was estimated at 135 TWh, projected to grow four times by 2037-38. Also, the per capita space cooling energy consumption is low at 69kWh per person compared to the global average of 272 kWh per person.

**On assessing market for refrigerants in India, how do we fare when compared to the international market? What is the kind of market demand for refrigerants and solutions?**

Choosing the right refrigerant has become more complicated, as it is critical to ensure a balance between energy efficiency and minimal environmental impact. The annual indigenous production of refrigerants in India was around 24,300 MT in FY18 and is likely to grow to 1,66,000-1,81,000 MT by 2037-38. This is very low compared to the global market, which is led by China, the US, and Europe. With the help of India Cooling Action plan and other energy efficiency measures, the demand is anticipated to reduce by 25-30% by 2037-38.

**What are the updates within the industry concerning the refrigeration sector in India?**

The penetration of domestic refrigerators in India is currently at around 33%, hence there is sufficient headroom for growth. The Indian refrigerators market is categorized into two product types i.e. Direct Cool and Frost Free. According to Frost & Sullivan's analysis, Direct Cool refrigerators dominate the market with almost 75% share. However, the popularity of Frost Free refrigerators is growing, especially among urban households. Commercial Refrigeration market

in India is highly fragmented, with the presence of many regional and local suppliers. Large players in the past have taken initiatives to organize the market for certain product categories. The major national players enjoy around 70% market share. However, the remaining 30%, is fragmented with the presence of 40+ players across regions and cities. The market expects to see a slowdown in the near future due to COVID-19 impact, as there will be dearth in sales across key end-user segments.

**What are the various technologies in place for the sake of next-generation refrigeration and cooling solutions?**

Next-generation refrigeration and cooling include various technologies, such as Ammonia-water VARs, Solar Assisted Cooling, Inverter Technology, and Heat Recovery. Ammonia-Water VARs (Vapor Absorption Refrigeration) - As water has a strong affinity towards ammonia, they are used in various operating conditions. Ammonia water solution has high stability and functions better with most materials except those that can easily be corroded, due to the presence of ammonia. In Ammonia-water VARs, ammonia is used as a refrigerant and water is used as an absorbent. Both ammonia and water are generated from the solution in the generator.

Solar Assisted Cooling - This system comprises solar collectors, storage tanks, control units, pipes and pumps and a thermally driven cooling machine. Solar Assisted Cooling (SAC) provides additional pre-cooling for chilled water/condensers of compression systems. It is an interesting alternative to reduce the power consumption of conventional cooling systems and reduce the carbon footprint. Inverter technology - similarly, in space cooling inverter technology, is gaining more prominence currently in room air conditioners, is expected to spread across commercial HVAC. In VRF (Variable Refrigerant Flow), most of the suppliers in the market have launched 5th generation VRF technology with advance dual inverter compressors. Heat Recovery Systems - Compared to heat pumps, heat recovery systems have lower energy requirements and

facilitate efficient heat management. Due to the growing awareness among consultants and contractors about the advantages of heat recovery systems, the growth of the market is witnessing a major boost, according to Frost & Sullivan's analysis.

**India is also a signatory to the Paris Agreement. How do we stand as a country in meeting regulations to achieve a low-carbon footprint?**

India has played a key role by signing the Kigali Amendment, which aims to phase-down the hydrofluorocarbons (HFCs) by reducing their production and consumption and the Montreal Protocol, which aims to phase out Hydrochlorofluorocarbons (HCFC) by 2030. India has maintained that it will meet its 2030 targets ahead of schedule. Also, it has recognized the connection between the energy efficiency of HVAC equipment with the transition of refrigerant. Recently, Environment Minister Prakash Javadekar mentioned that India along, with six other countries are on the path to achieving the NDC (nationally determined contributions), where India is leading the list.

India's national climate action plans, in accordance with the Paris Agreement, has set three major goals:

- Increase the share of non-fossil fuels to 40% of the total electricity generation capacity.
- To reduce the emission intensity of the economy to 35% by 2030 from 2005 level.
- To create additional carbon sink of 2.5-3 billion tons of CO<sub>2</sub> equivalent through additional forest and tree cover.

Studies by various research agencies have clearly shown that India is committed to achieving the goals set in the Paris agreement. A recent analysis by the Institute for Energy Economics and Financial Analysis (IEEFA) indicates that India is expected to achieve its energy capacity and emissions intensity goals by 2020.

**Considering the onset of COVID-19 being a game-changer, how would businesses have to rewrite the script through which they function?**

Companies should focus more on online sales, as the footfall to retail stores will be reduced in the future. With the increasing trend of online retailing, suppliers can achieve the target. At the manufacturing front, most suppliers are dependent on imports for various components from China and other countries. OEMs (original equipment manufacturers) can now focus more on localization, which helps with the supply chain challenges they are currently facing. They need to partner with multiple local vendors and not depend on a single source of supply. OEMs need to have

predictive analysis in place, to meet the demand for components/supplies in advance and keep the stock ready during the production phase. Installation, maintenance, and service staff should be trained to service customers while using PPE (personal protective equipment) kits.

**From the industry perspective, what are the pressing questions that need to be addressed concerning HVAC applications, meeting client and also market demand?**

Energy efficiency and reducing OPEX (operational expenditure) are becoming the primary concerns for customers, especially in key end-user segments such as commercial, data centers, and industrial clients. Establishing a clear balance between current and forecasted cooling demand through modular design while ensuring optimum performance will prove critical.

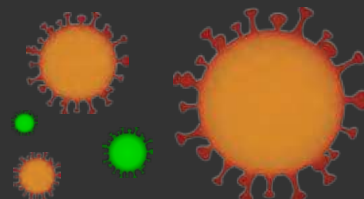
**Tell us about technological advancement and the call for energy-efficient solutions, how big is this demand?**

Energy efficiency in Cooling Technologies is the need of the hour. India Cooling Action Plan (ICAP) and District Energy in Cities Initiatives are expected to drive the demand for efficient District Cooling technologies in India. Ministry for Environment, Forest and Climate Change's ICAP has set out certain targets to achieve in the next 20 years such as - reducing cooling demand to 20-25%, reducing refrigerant demand, reducing cooling energy requirement by 25-40%, and recognizing thrust of research and providing training and certification synergizing with skill India mission. Thermal storage and district cooling are new technologies that have a significant role to play in building and appliance efficiency.

**What are the updates concerning policy and regulation around refrigeration and what role can the Government play for the future?**

To increase energy efficiency, apart from the room air conditioner and refrigerator, the Government has implemented testing and star labelling for unitary products (Cassette AC, Tower AC, Ceiling/Floor AC, and Corner AC) up to 3 ton capacity in the year 2018-19. Similarly, in 2018-19 there is an update to the Commercial ECBC (Energy Conservation Building Code), which provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements. The code applies to buildings or building complexes that have a connected load of 100 kW or greater, or a contract demand of 120 kVA or greater, intended to be utilized for commercial purposes. ■

# VIRUS DEACTIVATION TECHNOLOGY FOR HUMAN SAFETY



**D**esigned for new reality, in the period of social distancing, to highlight disinfecting concerns and deactivation of corona virus with focus on human safety, a webinar press conference was organised by Blue Star on **October 7, 2020**. Opening the conference session, **B Thiagarajan, Managing Director**, as panel spokesperson, remarked, Blue star range follows vocal for local because of manufacturing in India for 77 years, and we are fully alive to the 'Atmanirbhar' mission. By and large most of the products are manufactured by the company in India.

He elaborated, Blue Star's new launches and range of products and solutions incorporate Virus Deactivation Technology (VDT) and have capability to deactivate viruses including COVID-19 (SARS-CoV-2). The Covid-19 virus can be deactivated with upto 99.9% efficacy when the air passes through these systems. Most of the VDT components have also been designed to be easily retrofitted into existing AC systems, both central and unitary, in the field. These VDT solutions will be useful for all air conditioning applications, be it at homes, ATMs, showrooms, restaurants, offices, or large commercial spaces like malls, cinema theatres and airports. It is pertinent to note that the product is not a substitute to the mandatory precautions prescribed by the Government such as wearing masks, social distancing, usage of hand sanitisers and surface hygiene practices.

**Science behind this technology:** Tested in Arizona BioDetek laboratory, the project report tested antiviral efficacy against human corona virus 229E with 99.7% kill rate and with two layers 99.999% kill rate. The following components form the critical part of VDT.

- **Livinguard Filter:** Blue Star offers the 'Livinguard' filter which, through its positive charge, attracts the negatively charged viruses including COVID-19 (SARS-CoV-2) and other microbes, like a powerful magnet, and completely deactivates them when air passes through this filter.
- **UVC Emitters:** UVC germicidal properties are useful for disinfection and sensing. UV light with a wavelength range 200nm to 280nm is considered to have germicidal properties meaning it can kill bacteria and viruses.

Blue Star has also integrated Ultraviolet Germicidal Irradiation or UVGI technology into its VDT range of solutions. The UVC emitters that are placed in the air conditioning systems irradiate viruses including COVID-19 (SARS-CoV-2) by altering their DNA/RNA. This effectively deactivates the virus present in the air which passes through the air conditioners. New range of VDT products and solutions with retrofitting on existing machines possible:

- **Room ACs with Livinguard filter:** The virus is deactivated when the air passes through the filter. One of the product variants also assures an air purification level of PM 2.5.

- **Room ACs with UVGI:** Virus is deactivated when the air passing through is exposed to the UV lamp.
- **Ducted ACs with Livinguard filter:** Virus is deactivated when air passes through the filter inside the indoor unit.
- **Ducted ACs with UVGI:** Virus is deactivated when the air passing through is exposed to the UV lamp installed inside the indoor unit.
- **UVC Tower with Ozone generation:** This intelligent, movable and CE certified UV Tower dynamically computes the dosage required to de-activate the viruses and bacteria. It is augmented by an Ozone generator for full disinfection in difficult-to-reach spaces.

**Other unique services and solutions:** The company also offers solutions that help improve indoor air quality, disinfect air and surfaces, and augment fresh air in large conditioned places thereby preventing the spread of viruses including COVID-19 (SARS-CoV-2) virus, in these closed spaces, be it at home, workplace, or commercial spaces like hospitals and malls, amongst others.

- **Duct cleaning:** Blue Star is a certified member of National Air Duct Cleaner's Association (NADCA). The Company's Air System Cleaning Specialists certified by NADCA, render efficient service every single time regardless of the complexity of the project.
- **Hand-held surface disinfectant wand:** These solutions decontaminate surfaces infected with mould, bacteria or viruses by using hand-held devices. The wand may be used in any type of residential, commercial, industrial or institutional building to provide a fast-acting, portable method of decontaminating tabletops, walls and other surfaces.
- **Portable air and surface disinfectant:** Mobile units are equipped with multi-patented, high output UVC technology and is a portable in-room unit.
- **Fresh air ventilation solution:** Treated Fresh Air Units (TFAs) provide a solution for dilution of the conditioned air with induction of fresh air. The fresh air ventilation system can reduce the intensity of transmission of infection aerosols by dilution of air.

**B Thiagarajan, MD, Blue Star Limited,**

adds, "Virus Deactivation Technology provides additional protection against viruses including COVID-19 (SARS-CoV-2), in air conditioned spaces. Apart from being completely safe for humans, the above technology deploys components that are non-hazardous, eco-friendly, proven and accepted across the world. The new range of products and solutions, when used while adhering to the safety protocols mandated by the government, will provide additional protection to human beings inside air conditioned spaces."





# Impact of COVID-19 on Trends of Packaging in Food Industry

The article explores changing trends in food packaging technology which is replacing conventional and loose retailing of food items, particularly, as corona has impacted food and beverage packaging industry. The rising demand for sustainable packaging materials among consumers will drive the growth prospects for the global biodegradable bio-plastic packaging materials market.

**H**uman race is experiencing a very tough time fighting an invisible enemy; the novel Covid-19 corona virus. Personal hygiene and physical distancing are the only ways to avoid spread of the Covid-19 pandemic. Corona Virus has great impact on food and beverage packaging industry.

In this era, demand of packaged food will increase when compared with the loose stuff. Packaged food needs to maintain the food hygiene and consumer's trust to substantiate that the food material has not come in contact with any Covid-19 positive person.

Food packaging as a vital part of the subject of food technology is involved with protection and preservation of all types of foods. Due to economical abundance, petrochemical plastics have been largely used as packaging material due to their desirable properties of good barrier properties towards  $O_2$ , aroma compounds, tensile strength and tear strength. Meanwhile, they have many disadvantages like very low water vapour transmission rate and the major disadvantage is that they are non-biodegradable and result in

environmental pollution. Keeping in view the non-renewable nature and waste disposal problem of petroleum, newer concept of use of bio-plastics came into existence. Bio-plastics of renewable origin are compostable or degradable by the enzymatic action of micro-organisms. Generally biodegradable polymers get hydrolyzed into  $CO_2$ ,  $CH_4$ , inorganic compounds or biomass. The use of bio-origin materials obtained through microbial fermentations, starch and cellulose has led to their tremendous innovative uses in food packaging in the last few years. Biodegradable packaging is the need of present time.

## Introduction

COVID-19 is the infectious disease caused by the most recently discovered corona virus, originated in Wuhan, China in December 2019, and it has already claimed more than 45,000 deaths worldwide. The virus has spread in many parts of the world, including India, where total cases count nears about 1,39,928 and death toll up to 4,039 with the increment @ 7,111 patients daily as on May 25, 2020. COVID-

19 has affected the living culture of human being as well as many industrial fields too. It has direct impact on the economy and the packaging sector.

Food packaging is necessary to provide protection, tampering resistance, and special physical, chemical, or biological needs. It bears a nutrition facts label and other information about food being offered for sale. A decade back, people in small towns and rural places used to buy most of the staple items such as salt, sugar, oil or atta packed in loose polybags. There were issues of hygiene, spoilage and wastage due to lower shelf-life of loose items. Due to packaging needs, rural and small towns have started getting packed, branded stuff of higher quality. In the immediate future, packaging technology will be so flexible that people will buy packed rice and wheat, which will be much healthier, compared to loose packaging. However, Covid-19 has raised concern over the health and safety of what we are consuming and fuelled the demand of single-use plastic.

In past few months, a trend of removing unnecessary packaging, particularly in





fresh produce, has started. But as people are becoming more aware of corona virus being transmitted through surfaces, they will hesitate to pick any food without proper packaging. They will instead ask this question to themselves before choosing, who else has touched unpacked food item? The fact is that plastic has helped to fight this battle with its use, especially in healthcare and gone onto save people's lives, should be appreciated. Also, with extra attention being given to hygiene issues, disposable plastic cutlery seems to be back in favor. But the single time use of plastic will impose the excess environmental pollution and thus, creating the need for more sustainable solutions that includes environment-friendly packaging. However, current situation demands to temporarily shift towards plastic packaging, as it can help maintain sanitization of products during supply chain from manufacturers to consumers. Plastic packaging will help to contain the products inside the packaging without any un-necessary human touch ensuring higher safety levels. Nevertheless, non recyclable plastic packaging must be replaced with biodegradable bio-plastic packaging in order to ensure environmental well-being.

Biodegradable materials are materials that are readily decomposed by the action of microorganisms. Biodegradable packaging differs from conventional non-degradable packaging in terms of raw materials, production technology, applications, and composting. Biodegradable materials such as bio-plastic and paper are widely used in packaging applications because of their sustainable nature, material properties, and appearance.

### Biopolymers

Biopolymers are polymers produced from renewable sources such as plant raw materials. Polymers from renewable resources are different from natural polymers because their synthesis is induced intentionally. Conventional polymers are not biodegradable because of long chains of molecules that are too big, and too well connected with each other enabling non-separation either by the microorganisms or breaking down. Unlike conventional polymers, polymers made from natural plant materials from wheat, potato or corn starches have molecules that are easily degraded by microorganisms. Biopolymers are classified into four categories *i.e. Polysaccharides, Starch, Cellulose, Polylactic Acid*.

There are various companies, which are already using biodegradable packaging and compostable disposals for their food products. World Centric's US is one of them, who made line of compostable cutlery and packaging that includes an extensive list of biodegradable bags, dishware, and cutlery for household or corporate use. These certified-compostable disposables are made out of perennial plant fibers with long roots that help store carbon underground. Similarly, Papelyco makes Plantable paper plates. If you use their plates, and place it in the ground, then a plant will literally grow out of it. They even include important minerals in the plate to provide your new seedling with the nutrients it needs to grow. EcoWare, a New Zealand company, is a carbon neutral company, offsetting all of its energy output by investing in clean technology. Aside from their biodegradable dishware, they also sell bioplastic packaging that has an 80 percent lower carbon footprint than regular plastic. Tipa produces a line of biodegradable flexible plastics like Ziplock bags, garbage bags, etc. This type of plastic is heavily used by consumers, and can be a game-changing technology moving forward into a more sustainable future.

### Disadvantages of Bio-plastics

Besides the uneconomic feasibility of bio-plastics in contrast to traditional packaging, there are certain other disadvantages that limit their use in the present time. The use of land for the production of bio-plastics is a major hurdle in the success of bio-plastic functionality. Properties of certain bio-plastics like thermal instability, difficult heat seal ability, brittleness, low melt strength, high water vapour and oxygen permeability of PLA limit their use as films in food packaging applications. Other starch- and cellulose-based packaging materials due to their hydrophilic nature possess low water vapour barrier, which is responsible for poor process ability, brittleness, and vulnerability to degradation, limited long-term stability and poor mechanical properties. In case of PHA/PHB stiffness, brittleness (due to high glass

Table 1: Applications of different bio-based plastics in packaging

| Biodegradable materials  | Film   | Rigid (Trays/Cups)  | Bottles  | Other uses   |
|--|--|---|--|--|
| Starch blends  | Food waste bags, translucent grocery bags. Vegetables and fruits. Mulch films.   | Vegetables and fruits. Coffee capsules  | N.A.   | Loose fill foams. Service ware. Labels.                                |
| Cellulose based  | Cellophane, candy wrapping   | N.A.  | N.A.   | Some cellulose acetate in cutlery                                      |
| Polylactic Acid (PLA)  | Fresh cut vegetables & fruits, flower wraps, bread bags, shrink films.   |   |  |  |
| Not for long shelf life products, unless barrier laminates will be used. | Salads, vegetables, fruits, dairy products, bakery, drinking cups, meat. Avoid storage of empty trays and cups at high temperatures. | Not a preferred material. Used in small water bottles and chilled, short shelf life juices and dairy products, and wine bottle capsules. Needs barrier materials for further applications | Compostable teabags and coffee capsules. Coated paperboard (coffee cups) and other service ware. Foamed trays and boxes. |  |
| Biodegradable polyesters   | Grocery bags. Vegetables and fruits. Frozen produce.   | Vegetables and fruits (non- transparent)  | N.A.   | Biodegradable nets. Coated paperboard. Particle foam. Coffee capsules. |

(Reference: Oeveret. Al. 2017)

transition and melting temperatures), thermal instability and poor impact resistance also restrict their applications in food packaging. The above mentioned drawbacks have opened gateway of research for improving the functionality of bio-plastics.

Many different methods have been employed to overcome above mentioned disadvantages of bio-plastics especially for improving gas and water barrier properties. Some of the strategies are coating, blending, addition of nanoparticles, addition of cellulose, chemical/physical modification, etc.

## Conclusion

The rising demand for sustainable packaging materials among consumers will drive the growth prospects for the global biodegradable bio-plastic packaging materials market until the end of 2021. The market is witnessing a high rate of adoption of biodegradable or ecofriendly materials by retailers and intermediaries for packaging purposes because of various initiatives taken by governments of many countries to promote the use of sustainable packaging materials. Also, factors such as the growing consumer awareness, change in consumer attitudes, rising preference towards the environment-friendly packaging materials in the food and beverages packaging sector, are increasing demand for these packaging materials from retail outlets, will also fuel the market's growth. Biodegradable packaging has a bright future in the food industry. A number of factors

including policy and legislative changes, as well as world demand for food and energy resources, will undoubtedly influence the development of biodegradable packaging. There is no doubt that the production of and demand for this packaging will be more and increase partly because of improved properties of bio-degradable packaging and partly due to the decrease of its price, which is now unacceptable in relation to the price of other conventional packaging materials. ■

### Varsha Kanojia

Punjab Horticulture Postharvest Technology Centre, Punjab Agricultural University, Ludhiana.

### B. V. C. Mahajan

Punjab Horticulture Postharvest Technology Centre, Punjab Agricultural University, Ludhiana.

### Swati Kapoor

Punjab Horticulture Postharvest Technology Centre, Punjab Agricultural University, Ludhiana.





## AMMONIA GAS LEAK DETECTION SYSTEM FOR AMMONIA REFRIGERATION PLANTS

**I**ndustries like food, beverage and chemical factories use tons of Ammonia for refrigeration purpose. Ammonia is a commonly used refrigerant in many refrigeration units due to its low cost, high energy efficiency and negligible environmental impact. However, its high concentrations can directly be lethal. Ammonia is a gas which is not only toxic but also flammable.

Due to the huge amounts of ammonia in storage, these industries require Ammonia gas leak detection systems for safety and protection of personnel and property and to alert adjacent facilities and neighborhoods of a gas release.

Since inception, Ambetronics Engineers Pvt. Ltd., has detected ammonia gas leaks and also mitigated the risk associated with it like an expert.

Ambetronics Gas Detectors use electrochemical sensors which are accurate at high levels of humidity in freezers as well. The measurement ranges of ammonia gas sensors vary from 0 – 100 PPM, 0 – 1000 PPM or 0 – 100 % LEL, depending on the client's requirement.

Ambetronics has an exceptionally effective alarming system which alerts the workers and personnel whenever the

concentration of leak goes beyond the permissible limits (TWA: 25 PPM & STEL: 35PPM).

The Ambetronics make gas detectors are configured with Ambetronics make gas monitors whose relay output operates the exhaust fans automatically and thereby ventilates the cold rooms.

This guarantees safe and controlled atmosphere inside the cold room as well as it cautions the workers before entering the room.

With timely ammonia gas leak detection through Ambetronics make ammonia gas detector, the preventive measures can be taken care of by:

- Quickly responding to the alert signals,
- Automated ventilation,
- Immediate evacuation of personal from the site, and
- Taking disaster management actions.



**Ashish Shah**  
MD, Ambetronics Engineers Pvt. Ltd.

An HVAC System is an essential part of any residential or commercial building for producing indoor thermal comfort. The HVAC systems are designed to control the changes in indoor environmental conditions due to outdoor seasonal variations within a building through heating and cooling the space, regardless of the time of year. Energy efficient HVAC systems are required to be installed both for residential and commercial applications as they require less energy to work which ultimately reduces operating cost in the long run. Since HVAC energy usage has serious environmental impacts, increasing efficiency is crucial to minimizing detrimental global warming effects. Below, learn about every stage of the HVAC process, including design of equipment, installation, maintenance and system use.

# FACTORS THAT CONTRIBUTE TO ENERGY EFFICIENCY IN HVAC

**E**nergy consumption through heating, ventilation and air conditioning represents a significant portion of nationwide energy usage. The HVAC equipment accounts for nearly 40 percent of energy usage in both residential and commercial buildings. According to DOE, energy used by homes creates twice as much greenhouse gas emissions – recognized to contribute to climate change – compared to cars. HVAC usage in a single entity (e.g. commercial or residential building) can vary widely from one place to another. Heating and cooling efficiency is the most effective way that people can decrease their overall

energy consumption. HVAC equipment that is currently available has different degrees of possible efficiency. However, this is only the beginning. Experts consider the spectrum of efficiency rates, factoring in differences in equipment, quality of installation and maintenance, as well as personal use. Based on all of these factors, the Department of Energy (DOE) and many professional organizations conclude that much can be done to improve the HVAC efficiency of virtually any single system.

Considering HVAC processes, improved or advanced HVAC equipment and components are available in the





market may be purchased and installed, replacing existing inefficient components. The commonly used typical HVAC energy usage of HVAC components may be divided into five categories, these are; fans, cooling, heating, pumps and cooling towers. The energy usage of fans, cooling and heating account for 34%, 27% and 17%, respectively. Pumps and cooling towers are responsible for 16% and 6%, respectively. In hindsight, replacing existing equipment, responsible for these energy-intensive processes with higher efficiency equipment, may offer other substantial savings. Furthermore, existing systems are usually outdated and subjected to poor performance, due to degradation over time. The main contributor to the degradation of these systems may be a result of continuous operation, poor maintenance and prolonged exposure to environmental conditions.

Moreover, recently developed equipment may offer substantial improvements in terms of energy efficiency. For

instance, the use of variable speed drives to control compressor systems in chillers, as opposed to standalone fixed speed compressors, may offer substantial savings in terms of energy consumption in HVAC. A demand response component is introduced recently, as opposed to the constant supply of compressed refrigerant being delivered by the conventional HVAC system. In addition, variable speed drives have similarly been introduced to water pumps and fans, to obtain further efficiency gains. Pumps are located in both the evaporator and condenser sections, while fans, responsible for heat extraction and airflow regulation, are located at the condenser section and the air-handling units, respectively. Other improvements in HVAC design may incorporate permanent magnet synchronous motors, rather than induction motors, offering average energy-efficiency gains of up to 10.4% across the total speed range. To put this into perspective, the overall energy savings in HVAC systems may be as high as 8.58% as a result of replacing induction motors. Permanent magnet synchronous motors may replace all existing induction motors in the HVAC system, so that overall energy efficiency may be increased. Additionally, the permanent magnet synchronous motors usually operates near constant efficiency of approximately 96%, at any given speed percentile.

Multi-stage heating and cooling systems conserve energy by adapting to different temperature needs in the HVAC. The word stage refers to the level of power the machine uses to heat and cool the indoor space. A single-stage unit provides only one level of heating and cooling regardless of temperature needs. In other words, the HVAC unit cools the indoor space with the same level of power regardless of how hot it is. This scenario isn't always the best use of energy, and generally results in higher utility bills. Multi-stage units save energy by alternating power settings to conserve energy and run on low power settings most of the time. Under more extreme conditions, the units switch to higher modes of power.

HVAC models that are more than 20 years or older are needed to be replaced as they are likely to be less energy efficient. In addition, heating and cooling systems lose their efficiency over time. The average lifespan of these HVAC systems is about 15 to 20 years. If HVAC equipment is available more than 10 years, it needed to be replaced as the consideration of the cost effectiveness of the maintenance on an older system. Making repairs might improve its efficiency and offer some benefits, but ultimately the repairs will extend the life of an older system, especially with significant damage or wear and tear.

When considering an energy-efficient cooling or heating system, It is necessary to select the proper energy ratings of HVAC. Such as in Seasonal Energy Efficiency Ratio, SEER, for air conditioners and an Annual Fuel Utilization Efficiency, AFUE, rating for furnaces. Higher ratings indicate that the machine uses less energy to heat and cool your home. Heat pumps can come with both SEER rating and Heating Seasonal Performance Factor, HSPF, which measures heating efficiency.



## Factors affecting energy efficiency in HVAC

When it comes to the operation of HVAC devices and machines, energy efficiency is the first thing people look for. It is no different for HVAC systems, which can take up a significant portion of energy costs in both residential and commercial applications. Different factors will make HVAC an system energy efficient. From the type of system to how it is maintained can all affect the energy efficiency. Because of this, even small changes to an existing system can help make it more energy efficient.

## Efficiency in HVAC Design

Efficiency applies to design of HVAC equipment, as well as use. Experts suggest taking a holistic approach to decreasing energy consumption, by examining all the ways that each part of the HVAC system uses energy and looking for ways to improve it. Demand-controlled ventilation is key to reduce the cooling or heating load so that buildings are not cooled or heated regardless of the needs of the building's inhabitants. Designers should aim to use renewable energy sources whenever possible. Since heating and cooling tends to produce a lot of waste, HVAC system designers ought to take advantage of natural conditions or by-products to more effectively heat and cool. For example, the system may be built to use heat exhaust to warm air or utilize natural moisture to cool air.

Assuming that the heating and cooling equipment is designed with the greatest efficiency in mind, the most significant impact on effectiveness comes from the installation, maintenance and use of the system. All equipment for the HVAC system must be expertly installed to ensure that the maximum amount of cooled or heated air will reach all specified areas of the building. Once installed, the equipment should be maintained regularly and repaired, as needed. This includes appliances such as furnaces and air conditioners, but also auxiliary equipment like ductwork, which can be a significant source of wasted energy. DOE recommends that people in all buildings use programmable thermostats efficiently to minimize energy consumption. It also suggests that building managers and home owners take a proactive stance toward a decrease in energy consumption. When HVAC users plan to reduce their energy usage, they are more likely to succeed. HVAC efficiency allows people to use their HVAC equipment to cool or heat buildings without wasting energy unnecessarily. Given the contribution of HVAC energy consumption to global greenhouse gases, improvements to these systems through design, installation, maintenance and use are vital to any environmental conservation plan.

## Rating of HVAC system

When it comes to finding the most energy efficient HVAC system, it helps to have an understanding of the criteria behind them. Here are some of the different scientific ratings most energy efficient HVAC systems will be rated with the Season Energy Efficiency Ratio (SEER). The SEER is the measured ratio of cooling output, which is measured in British Thermal Units

(BTU) and then divided by usage, measured in kilowatt hours. For the SEER rating, the higher the number, the more energy efficient HVAC ducting you have. The SEER HVAC rating uses seasonal cooling conditions rather than lab-created conditions. Energy Efficiency Ratio (EER) is the another rating most energy efficient residential HVAC systems will have is an EER rating. The EER rating does not use seasonal averages to get its ratios. Instead, it uses strict laboratory conditions for its testing. Like with the SEER rating, the higher the EER number, the more energy efficient the HVAC system is. Heating Seasonal Performance Factor (HSPF). The HSPF rating is the ratio for how efficient the HVAC's heat pump is, which cycles in both directions to produce hot and cold air. The HSPF rating measures exactly how much total space heating is necessary, using the BTU measurement divided by the total amount of electricity used by the pump in kilowatt-hours. The higher the HSPF ratio, the more efficient the heat pump is.

## Proportional integral-derivative (PID) programming and Variable Speed Drive (VSD) and Variable Frequency Drive (VFD)

Due to the complex relationship among the HVAC system operational parameters, it is necessary to suggest optimum settings for different operations in response to the dynamic cooling loads and changing weather conditions during a year. Proportional integral-derivative (PID) programming can effectively handle the discrete, nonlinear and highly constrained optimization parameters. Energy efficiency process has been made by controlling of alternative current (AC) drivers for ventilation and exhaust fans, according to supplied air flow capacity and differential air pressure between supplied and exhaust air. In addition, supervisory controller softwares were also developed by using programmable controllers and human machine interface (HMI) units. The new designed HVAC control system would have a saving potential of about 40% as compared to the existing operational settings, without any extra cost.

In the old conventional control system, exhaust and ventilating fans had been driven at constant speed. The differential pressure sensors, anemometers, and driver inverters for exhaust and ventilating fans have been added to the new designed control system. In this manner, the exhaust and ventilating fans' speed have been controlled depending on the requirements of the plant conditions (Fig. 1). Fig. 1 shows the difference between a fixed speed and a variable speed compressor at different loads. The compressor motor control drive contains algorithms that enable the drive to operate efficiently and protect the compressor. These active protection algorithms incorporated into the motor control drive safeguard the compressor and drive from many adverse operating conditions.

In addition, the VSD will include soft start and possibly soft stop algorithms which save energy and reduce the stress on components. Many compressor manufactures offer a variable speed drive matched to the compressor and mounted on the

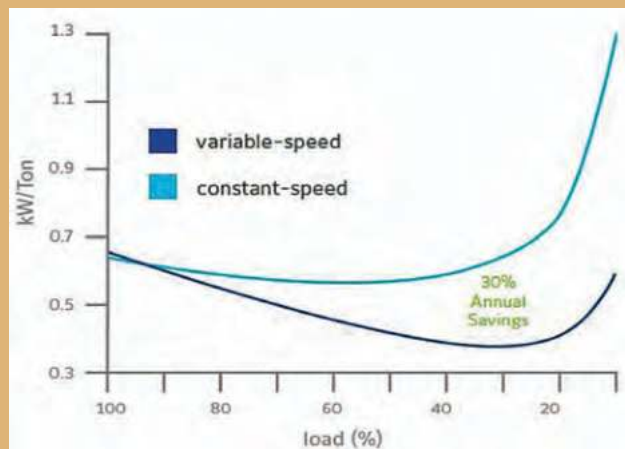


Fig. 1. Comparison of fixed and variable drives.

same frame as the compressor. Alternatively, a separate VSD may be retrofitted to existing equipment. Variable speed compressors can operate in the range from very low load ( $\approx 10\%$ ) to full load. Other improvements include the use of permanent magnet synchronous motors, which are particularly suited for VFD systems these offer improved efficiency over induction motor-driven units (Fig. 2). Other compressor improvements include oil-free magnetic bearing drives that reduce oil usage, have a lower number of parts and, therefore, lower maintenance requirements.

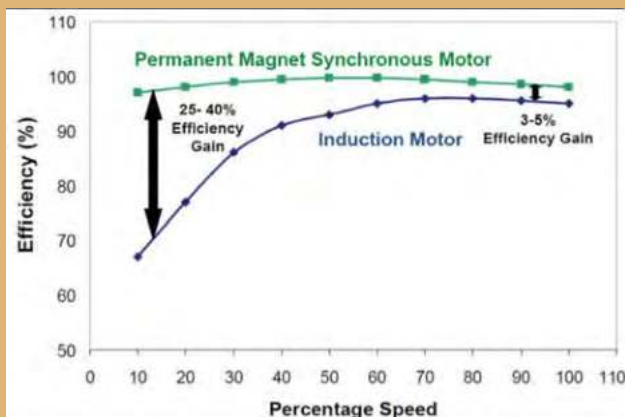


Fig. 2. Efficiency gains at low speed for permanent magnet synchronous motors.

## Indoor Air Quality

Poor indoor air quality (IAQ) will cause HVAC unit to work longer which will make it less energy efficient. Testing the indoor air quality in air conditioned room will help keep occupants healthy and HVAC system more efficient. Sometimes, the process cleaning the indoor air handling units and outdoor compressors may help to make HVAC system working better. To tackle these factors that determine HVAC efficiency and healthier indoor environment are results into more comfortable home and lower utilities. To improve HVAC system's efficiency, regular maintenance or service is required.

## HVAC System's Size (capacity)

Proper size (capacity) plays an essential role in HVAC system performance. If your system is too large for smaller cooling space, the system will spend excessive time in its power-wasting startup phase, which results in short cycling. If the system is too small for the large cooling load of the conditioned space, the heater or air conditioner will spend excessive time attempting to reach the thermostat's threshold, which it never does. Either way, poor sizing wastes energy. The HVAC professionals can diagnose whether or not system fits the load requirement of conditioned space area.

## Insulation of space to be cooled or heated

To have the most energy efficient residential or commercial HVAC system possible, it is to be ensured that the whole indoor space to be cooled or heated should be well insulated. By proper insulating the indoor space well and keeping the ducting of the HVAC unit properly, there is less of a chance of air escaping, so the installed HVAC unit will not have to work as hard to heat and cool indoor built environment overall.

When an energy efficient HVAC unit resulted to the leaky duct system, it completely defeats the purpose by allowing the air to escape before it reaches the indoor conditioned space. This is a costly issue that is often overlooked in HVAC maintenance and can costs a lot of money. By using a product like Aero seal, any cracks and holes will easily be filled, preventing any more air leakage (Fig. 3).



Fig. 3. Prevention of duct leakage by use of aero seal.

During summer months, keeping curtains closed during the day will help block out some of the summer heat, allowing conditioned indoor space to maintain a cooler temperature. Alternatively, opening the curtains during winter will allow even the smallest amount of sunlight to come through and naturally warm indoor space, so HVAC system works less.

## Fans and fan controllers

Energy saving on fans is much greater than on other equipment. On fan loads, the power requirement varies as the cube of the speed, so the slower the fan speed, the less energy required. A fan running at 80% speed will consume 50% of the energy at 100% speed. Modern fan controls consist of much more than just speed controls and variable speed drives. Key to identifying the energy savings opportunities of VSDs in HVAC systems is an understanding

of the operating cycle of the system versus the heating and cooling needs actually required. Most HVAC systems are designed to keep the building cool on the hottest days and warm on the coldest days. Therefore, the HVAC system only needs to work at full capacity on those days. For the rest of the year, the HVAC system can operate at reduced capacity. This is where a variable air volume system with variable speed drives (also-called variable frequency drives, or VFDs) can be used to match air flow to actual heating and cooling demands. The VSD can reduce the motor speed when full flow is not required, thereby reducing the power and the electrical energy used.

## Air distribution systems

The variable air volume system has advantages over the constant air volume system (feed a constant flow of air and regulate the air temperature to the heat load), but in the basic version has several drawbacks. In a variable air volume system, the air temperature is kept constant and the flow is varied to meet the heat load requirements. The basic method of control is to use a constant speed fan and a damper to regulate air flow. This provides the fan motor with a constant load irrespective of the air flow rate. Using a variable speed drive varies the load on the fan motor with variations in air speed and achieves energy savings as a result.

## Evaporator design

The evaporator is used to lower the temperature of the chilled water returned from the water circulation system. The water is passed through the evaporator in pipes surrounded by condensed refrigerant. The heat from the water evaporates the refrigerant and the water is cooled in the process. The flooded evaporator (Fig. 4) was commonly used in the past. In the flooded type, the refrigerant covers the tubes completely and evaporation of the mass of refrigerant takes place when returned chilled water is passed through the tubes.

In the falling film evaporator, the surface of the tubes in the upper portion of the evaporator is covered with a thin film of refrigerant, giving a very effective heat transfer mechanism. In the mixed falling film type evaporator (Fig. 5), a thin film of refrigerant is sprayed over the top tubes. Some of this evaporates and the gas passes on to the compressor. The remaining refrigerant covers the bottom tubes and evaporates as well.

The FF-type (full falling film evaporator) offers higher heat transfer efficiency and requires a lower charge of refrigerant than

the flooded type evaporator. In the full falling film evaporator (see Fig. 6), the film covers all the tube and the remaining refrigerant collects in the bottom of the evaporator. Only the evaporator bottom has a small amount of liquid refrigerant so that refrigerant charge is less, complying with environment protection.

## Central plant optimization and energy efficient operation

HVAC systems consist of a complex arrangement of different components, all of which must be controlled to work together. In a manually controlled system, each of the systems is set to its optimum condition, which might not be optimum for the system as a whole. Take, for instance, the air handling unit: There are two flows that can be controlled, the rate of air flow and the rate of water flow. The water temperature will depend on the evaporator settings, which also depend on the compressor and condenser settings. Optimization will require adjustment of the operation of all these units to achieve best efficiency. Optimizing energy usage in the HVAC system involves optimizing every element and the system as a whole. The operation of the system as a whole can be optimized to ensure further energy savings even once the individual items have been set for maximum economy. Central plant optimization can achieve further gains after equipment and motor drive upgrades. Up to 60% saving are claimed versus the existing plant before equipment and VSD retrofits. Some 15 – 20% savings are claimed to be possible compared to performance with upgrades only.

Comfort Point Open (CPO) systems can work with any brand of equipment or plant that can interoperate with building management protocols. Most work on well-established proprietary algorithms and practices. CPO is essential in larger buildings where there is more than one chiller plant running, and the heat load in different sections of the building follows a unique pattern, with no correlation with the pattern in other parts of the building.

## Conclusion

The maximum potential savings in the HVAC that has a large variance in the load requirements and climatic conditions has to be taken into consideration for optimum energy efficiency. Furthermore, terms of demand-side management of HVAC systems has also been taken into consideration particularly for the purpose of reducing maximum load demand. Moreover, additional quantifiable data is necessary for effective decision making, regarding the implementation of energy efficiency initiatives. ■

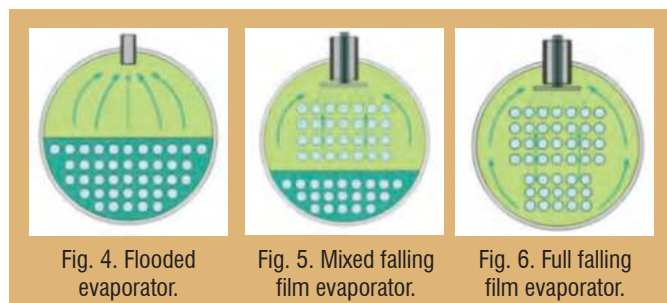


Fig. 4. Flooded evaporator.

Fig. 5. Mixed falling film evaporator.

Fig. 6. Full falling film evaporator.



**Dr. (Prof.) D.B. Jani**

Associate Professor at GEC, Dahod, Gujarat Technological University, GTU, Ahmedabad (Education Department, State of Gujarat, India).



# New Series AL Compressor and New compressor Models optimized for A2L-Refrigerants from Tecumseh

New Series AL Compressor delivers high efficiency in smaller housings for R-290-based refrigerated food retail and service equipment and new models optimized for A2L-refrigerants extend existing compressor portfolio such as Series AE and AJ.

**T**ecumseh Products Company LLC, a global leader and innovator of commercial refrigeration technologies, introduces a Series “AL” compressor platform with high efficiency optimized for R-290 refrigerants, and also expanding several existing platforms with new models that are specifically optimized for A2L refrigerants. Tecumseh unveiled these compressors at the virtual tradeshow: Chillventa eSpecial and ATMO America during October. As an official sponsor of

these events, Tecumseh showcased these new compressor platforms through live webinar presentations along with their recently introduced VTC-High Capacity, the latest variable-speed offering with extended cooling capacity.

## Series AL Compressor Platform for R-290

New Series AL Compressor platform is up to 15% better in performance and energy efficiency packed in a very compact body. In a quiet and small housing that is estimated to be roughly 5% shorter in height compared to competitive products, Series AL models provide up to 20cc displacements and are designed specifically for L/MBP applications in light commercial refrigeration. The expanded L/MBP operating range allows standardized use across display cases, reach-in coolers and ice machines applications.

Series AL, optimized for R-290 (propane) refrigerants, has capacities ranging from 1,240 to 1,800 Btu/h (0.36kW to 0.52kW) at LBP and from 3,730 to 4,990 Btu/h (1 to 1.5kW) at MBP both in EN12900 conditions. It delivers the same capacity as a larger displacement, single-speed compressor, making more room for merchandise in refrigeration units.

**Doug Murdock, the CEO of Tecumseh** remarked, “In Tecumseh’s history, we have produced a number of legendary



compressors such as Series AE and AJ. We are excited to introduce another game-changing platform that we believe will set the industry standard for the refrigeration community.”

## Expanding Portfolio with Low-GWP A2L Refrigerants

In addition to the new Series AL platform, Tecumseh is one of the first manufacturers in the refrigeration industry to

introduce new compressor models optimized for low-GWP A2L refrigerants such as R-455A, R-454C and R-1234yf. The platforms with those new A2L-ready models are Series AE2, AJ2, FH2 and AG compressors. Earlier this year, Tecumseh Europe released its ‘Silensys Advanced Condensing Unit’ equipped with some of the A2L-optimized compressors for the European market. The new A2L-ready compressors can be used in indoor or outdoor condensing units ranging from 1 to 20 kW, making it the perfect solution for cold rooms, display cases, refrigerated cabinets and beverage dispensers in food retails and services.

**Ernani Nunes, Sr. VP of Global Sales and Engineering at Tecumseh** said, “We have now further expanded our portfolio to provide highly efficient alternatives that satisfy the European F-gas regulations.” Compressors optimized with A2L refrigerants give customers great alternatives to mid-sized system requirements that are too small for a typical CO2-based system and too large for a R290-based system.

Using Tecumseh’s A2L offerings, design engineers at refrigeration OEM companies now have more suited choices to approach the refrigerant transitions without compromising system efficiency while meeting low-GWP requirements. ■





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# Cold Chain Logistics

MARKET WORTH FROM 2019–2026

The feature represents the analytical report of the global Cold Chain Logistics current trend and factors impacting, the market growth and restrictions.

Image by upklyak freepik

The global cold chain logistics market size was valued, at \$159,988.1 million in 2018. It is estimated to reach \$585,105.6 million by 2026, at a CAGR of 17.9% from 2019 to 2026. Asia-Pacific is anticipated to maintain its lead throughout the forecast period since 2019.

The cold chain refers as a combination of temperature-controlled transport and supply chain, essential for extending the products life, avoid overcapacity, reduce wastage during transit and maintain the quality of the products. The process involves the utilization of temperature-controlled warehouses for storage and cold isolated vehicles for distributing products. Cold chain logistics solutions are broadly used to transport and store agricultural produce, seafood, frozen food, chemicals, and pharmaceutical drugs. These products are transported, via modes such as refrigerated trucks, refrigerated railcars, refrigerated cargo and air cargo.

The cold chain helps reduce wastages of the decomposable products and commodities overall providing profitable prices to the farmers. In the pharmacy industry, it increases the ability of the drug throughout the supply chain to the end consumers. Increase in the number of refrigerated warehouses within the

food sector and the pharmaceutical sectors are estimated to drive the market growth of the cold chain logistics trend.

Factors such as lack of uniformity and high operational cost restrain the growth of the market. However, RFID technologies for cold chain applications and adoption of software provide lucrative growth opportunity for the cold chain logistics players.

## Factors influencing the growth of Cold Chain:

### Spike in refrigerated warehouses

Warehouses including, cold chain systems are designed ensuring the ideal storage and transportation conditions for temperature-sensitive products. Multiple export industries are dependant on such cold chain systems. Businesses invest millions of dollars in their cold chain operations to design an effective and efficient process as end-to-end cold chain security is the delicate link in the system. Furthermore, the growing online grocery sales in the U.S. market is likely to boost the demand for up to 100 million sq. ft. of cold-storage space over the next five years, according to the latest report from CBRE.

### Pharmaceutical logistic sector

Pharmaceutical manufacturers majorly focus on quality and



product sensitivity. Increase in development of more complex biological-based medicines, shipments of hormone treatments, vaccines and complex proteins that require cold chain refinements need to transport within a controlled temperature. Transportation of temperature-controlled pharmaceutical products and devices, witness significant growth in the healthcare logistics industry. The cold chain logistics sector will have to be swift at handling an increase in the volume and quality standards of goods and continually mounting regulations. Additionally, the entire cold chain supply chain and logistics for the pharmaceutical industry is becoming more strategic and reliable. There has been an increase in biopharmaceutical products at a rapid rate than small molecule drugs. The growth in vaccines is the reason for temperature-controlled pharmaceutical products to increase double the rate than that of the pharmaceutical industry as a whole. Hence, growth in pharmaceuticals is foreseen to fuel the Cold Chain Logistics market size.

### Factors restricting the Cold Chain market growth:

#### Operational cost

Operations in the cold chain logistics industry require massive electricity consumption making it difficult for cold chain service

providers to minimize their operational costs. Also, high energy and real estate costs are likely to make operating, process challenging. For instance, refrigeration consumes 53% of the total power in operations. Further, applications such as lighting, heating, ventilation and cooling consume a significant amount of electricity. Due to which high operational cost is anticipated to hinder the cold chain logistics market growth.

#### Lack of uniformity.

The lack of standardization and credibility are significant challenges to the Cold Chain logistics industry, where quality and availability of cold warehousing space is a concern at the moment. In many cases, companies have to invest supplementary to upgrade the space and its specifications to standards that support an individual industry segment as per their requirement. The standards formulated by the policymakers build pressure on developers. Upgrading the facility in terms of temperature compliance or accommodating automated equipment is challenging. Further, training and developing the manpower on the technology and handling the products involve heavy capital.

# UPCOMING EVENTS

## GREENBUILD INTERNATIONAL CONFERENCE & EXPO

Location: Virtual  
Contacts: +44 (0) 20 7017 5000

**10-12  
November 2020**

**15-17  
November 2020**

## RACC 2020 (INTERNATIONAL AIR-CONDITIONING, VENTILATION, REFRIGERATION AND COLD CHAIN EXPO)

Location: China  
Contacts: info@cantonfair.net

## REFRIGERATION & HVAC INDONESIA 2020

Location: Indonesia  
Contacts: info@refrigeration-hvacindonesia.com

**10-12  
December 2020**

**15-17  
December 2020**

## HVACR Vietnam 2020 (Second Revision)

Location: Vietnam  
Contacts: hvacrvietnam.mkt@informa.com

## HVAC R Expo Saudi 2021

Location: Saudi Arabia  
Contacts: info@dmgevents.com

**25-27  
January 2021**

# CONFERENCE

## The Fourth International Conference on Efficient Building Design and Productivity

**Date:** 5th-6th November 2020

**Location:** Virtual

**Organizer:** ASHARE

## Indoor Air (Conference)

**Date:** 01th - 05th November 2020

**Location:** Korea

**Organizer:** REHVA

## REHVA Brussels Summit 2020 (Conference)

**Date:** 05th November 2020

**Organizer:** REHVA



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